

# Crab Foundation – Research Update – September CPT - 09.14.23



Scott Goodman | Executive Director  
Bering Sea Fisheries Research Foundation

# Crab Foundation – BOD & Advisors



1. Doug Wells – CP Baranof, Pres.
2. Edward Poulsen – FVs Patricia Lee/Aleut. #1, V. P.
3. Frank Kelty – City of Unalaska, V.P.
4. Garry Loncon – Royal Aleutian Seafoods, Treasurer
5. Lenny Herzog – Fvs Saga/Tempo Sea, Secretary
6. Gary Painter – FV Trailblazer
7. Mark Casto – FV Pinnacle
8. Louie Lowenberg – FV Arctic Lady
9. Heather McCarty – Central Bering Sea Fish. Assoc.
10. Owen Kvinge – FV Arctic Sea
11. Shannon Carrol – Trident Seafoods
12. Sinclair Wilt – Westward Seafoods

1. Scott Goodman, ED
2. Dr. Gary Stauffer
3. Dr. Gordon Kruse
4. Ms. Madison Heller-Shiple
5. Dr. Tim Loher
6. - additional staffing soon -

Monthly Board Meetings – 3<sup>rd</sup> THU

## Timothy Loher, PhD

Martingale Marine Ecological Research  
7019 14<sup>th</sup> Ave NE  
Seattle, WA 98115 USA

Phone: (206) 522-4860  
Email: tim.at.martingale@gmail.com

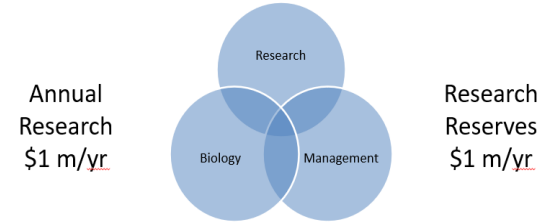
### EDUCATION

PhD in Fisheries, University of Washington, Seattle, Washington. 2001. Dissertation: Recruitment variability in southeast Bering Sea red king crab (*Paralithodes camtschaticus*, Tilesius 1815): the roles of early juvenile habitat requirements, spatial population structure, and physical forcing mechanisms.

MS in Marine Biology, Northeastern University, Boston, Massachusetts. 1992. Thesis: Cunner (*Tautoglabrus adspersus*) predation in the rocky subtidal: effects on juvenile barnacles and mussels.

BS in Biology (with minors in Chemistry and Secondary Education), State University of New York, Geneseo, New York. 1987.

## BSFRF → our status & what we are trying to accomplish



- Typical annual research revenues 0.7-1.0 million
- Last year we budgeted \$125k, cut our budget in half
- This year we budgeted \$40k, but there are new funds
- Our calendar year planning is more flexible – open now

## Current BSFRF Status and Plans – Research Funds

-- managing plans now w/ upcoming options --

\$mil

- \$1.40 ➤ Year-end reserve 2022, low revenues from crab landings
- \$2.75 ➤ CDS research support funds coming this year
- \$0.75 ➤ NPRB projects coming online, multiple years
- \$0.13 ➤ BREP projects continuing, likely smaller scale
- \$1.30 ➤ Disaster relief research funded projects, increasing scale
- \$0.85 ➤ Urgent research projects, underway now
- \$2.00 ➤ Further new research funds/plans, underway now

## ➤ Seeking research funds, focused areas

PROJECT – Description
<b>CRAB MOVEMENT RESEARCH</b> – smart tags (satellite/acoustic) and smart monitoring (drone) technology along with other traditional means to tag release and recover BBRKC and snow crab, are needed. Efforts to date have been limited by funds and sample size. A primary project would be to increase the number of sampled tags scaled 1x, 3x, 5x, or 10x to get more tagged crab out and to better cover the crab distribution in areas of particular interest. <b>Focus species: BBRKC, snow crab</b>
<b>CRAB SURVEY RESEARCH</b> – currently the BSFRF is determining a plan to conduct trawl survey, pot survey, and other survey efforts that would fill critical information gaps in the winter and spring periods when and where fishery or summer survey information does not exist. NMFS summer surveys provide a rich, long time series, but don't cover winter grounds, nor provide insight on mating/molting activity in time and space, which is needed now to consider necessary protections for crab. Surveys would also enable us to set tag results into the context of population densities. <b>Focus species: BBRKC, snow crab</b>
<b>HABITAT &amp; RECRUITMENT RESEARCH</b> – understanding of specific areas of crab habitat is lacking context with recent ecosystem and climate changes, and current fishing activities. Proposed tagging and survey research could be further specified to focus on precise areas (BBRKC: Amak Island, Black Hills, nearshore AK Peninsula, and snow crab: Pribilof Islands areas, canyon areas) that may reflect important breeding, nursery, and/or juvenile areas that may require designation. This research will help to fill huge gaps in knowledge about important recruitment areas. <b>Focus species: BBRKC, snow crab, Tanner crab, other king crab stocks</b>
<b>BYCATCH RESEARCH</b> – research has been completed to roughly estimate handling and discard mortality for crabs that are captured and released in both target and non-target fisheries. Given poor stock status, a research focus on bycatch and fishing impacts would provide more precision to these important estimates of mortality for sustainable fishery management. <b>Focus species: BBRKC, snow crab, Tanner crab, other king crab stocks</b>
<b>CRAB PREDATION</b> – longstanding research on cod stomachs provides a limited understanding for how much crab are eaten by groundfish (cod). Major gaps in time and space requires a focus on molting periods, when crab are most vulnerable, and nearshore areas occupied by young crab that have not been studied. This information is particularly critical now given changing ocean conditions that are affecting the overlap of groundfish predators with crab. <b>Focus species: snow crab, Tanner crab, BBRKC, other king crab stocks</b>

## ➤ Focused Research Areas

**CRAB SURVEY RESEARCH** – new efforts are needed to fill critical information gaps in the winter and spring periods. Summer surveys provide a rich, long time series, but don't cover winter grounds, or mating/molting activity in time and space, which would update protections for crab, and enable us to set tag results into the context of population densities.

**Focus species: BBRKC, snow crab**

### **COLLABORATIVE POT SAMPLING projects**



*Dr. Loher update*



*Opilio Pot Sampling – Planning Now (Pilot 2024)*

# ➤ Focused Research Areas

**HABITAT & RECRUITMENT RESEARCH** – understanding of specific areas of crab habitat is lacking context with recent ecosystem and climate changes, and current fishing activities. Surveys, tagging, and new research may reflect important breeding, nursery, and/or juvenile areas. This research will help to fill huge gaps in knowledge about important recruitment areas. **Focus species: BBRKC, snow crab, Tanner crab, other king crab stocks**

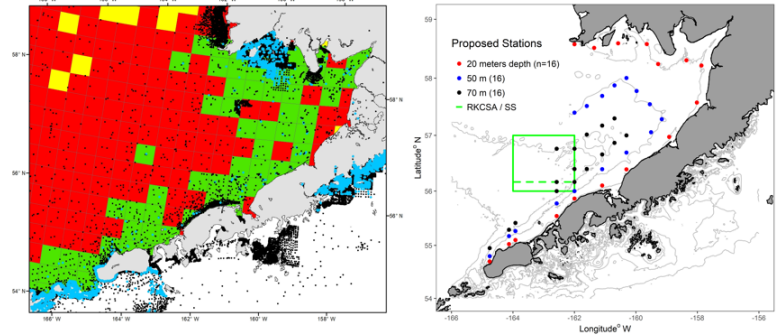
**Research is a blend of current plans on tagging/movement/survey work, and focused NPRB projects that are pending (start in early 2024)**

**BYCATCH RESEARCH** – there are estimates of handling and discard mortality for crabs in target and non-target fisheries. Given poor stock status, further focus on bycatch and fishing impacts would provide more precision. **Focus species: all BSAI crab stocks**

**Unobserved Fishing Mortality – UFM research**  
**BREP/Similar Projects – specific gear research**  
**Camera/Sensors - gear performance/some working ideas**  
**Collaborative approaches with other sectors**



**HABITAT & RECRUITMENT RESEARCH**  
**Research is a blend of current plans on tagging/movement/survey work, and focused NPRB projects that are pending (start in early 2024)**



**BSFRF charters are part of this project plan...**

**CRAB PREDATION** – understanding is limited for how much crab are eaten by groundfish (cod). Major gaps in time and space requires a focus on molting periods, when crab are most vulnerable, nearshore areas with young crab that have not been studied - this is particularly critical now given changing conditions that are affecting the overlap of groundfish predators with crab. **Focus species: all BSAI crab stocks – parts of this are connected to Madi's research**



# RESEARCH PRIORITIES

## NPFMC Top Ten Research Priorities for 2022-2024

1. Spatial distribution and movement of crabs relative to life history events and fishing.
2. Conduct routine fish, crab, and oceanographic surveys in the Arctic Ocean.
3. Develop a framework and collect economic information.
4. Develop stock-specific ecosystem indicators and incorporate into stock assessments.
5. Cooperative research efforts to supplement existing at-sea surveys that provide seasonal, species-specific information on upper trophic levels.
6. Develop tools for analyzing coastal community vulnerability to fisheries management changes.
7. Maturity estimates for Bering Sea and Aleutian Island crab stocks.
8. Collection of socio-economic information.
9. Gap Analyses on loss of biological samples due to implementation of Electronic Monitoring.
10. Norton Sound Red King Crab case study.

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### # Council Top 10 Research Priorities, 2022-2024

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1 Crabs - distribution/movement during life history & fishing

2 Arctic Ocean - routine multi-spp & oceanographic surveys

3 Economic information - framework and collection

4 Ecosystem indicators per spp - into assessments



5 Cooperative research - survey/seasons supplement

6 Community vulnerability analyses to management



7 Maturity estimates for BSAI crab stocks

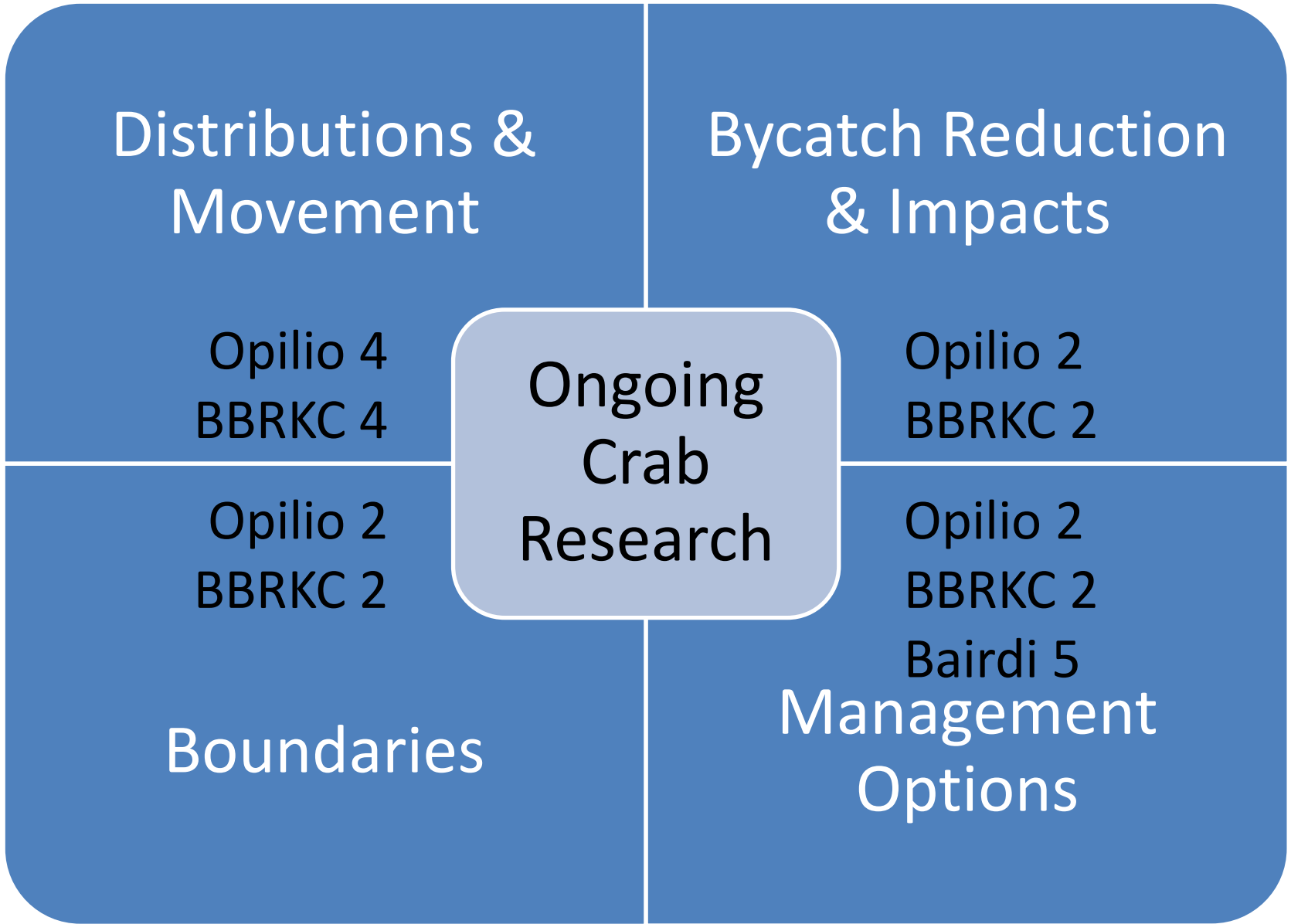
8 Socio-economic information collection

9 EM biological samples loss gap analyses



10 Norton Sound red king crab case study

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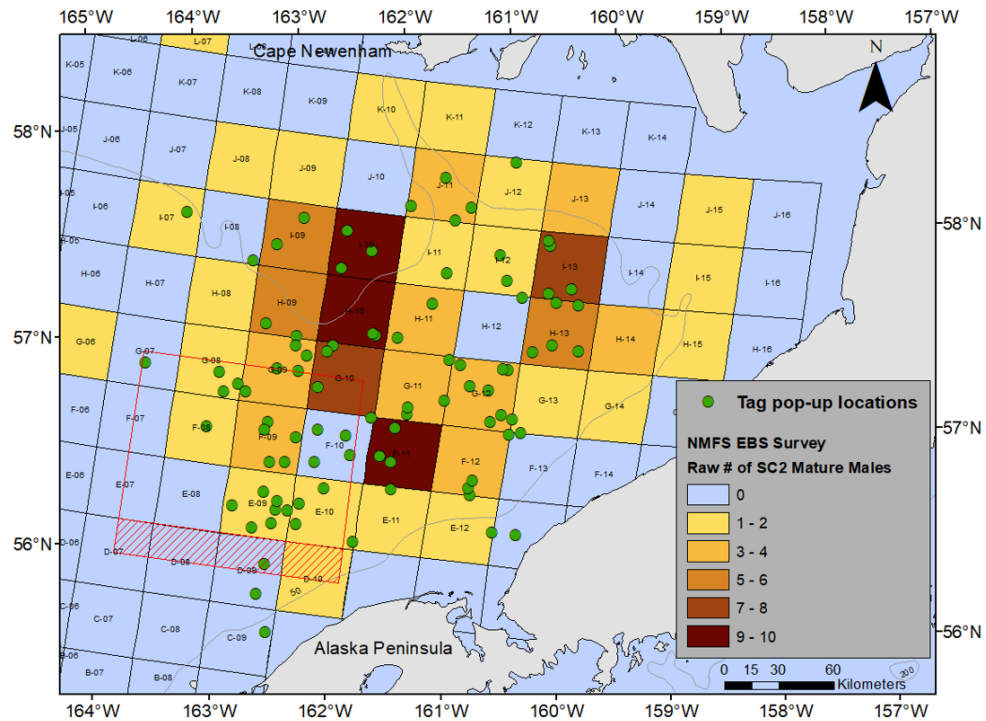
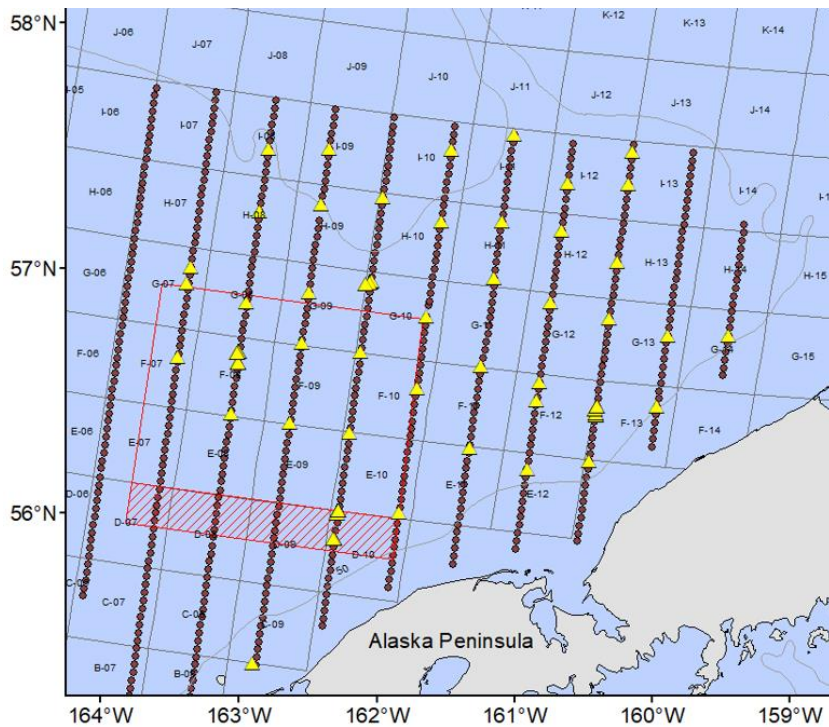


*Looking for continued feedback from stakeholders/collaborators during planning*

# Tagging on CPS1

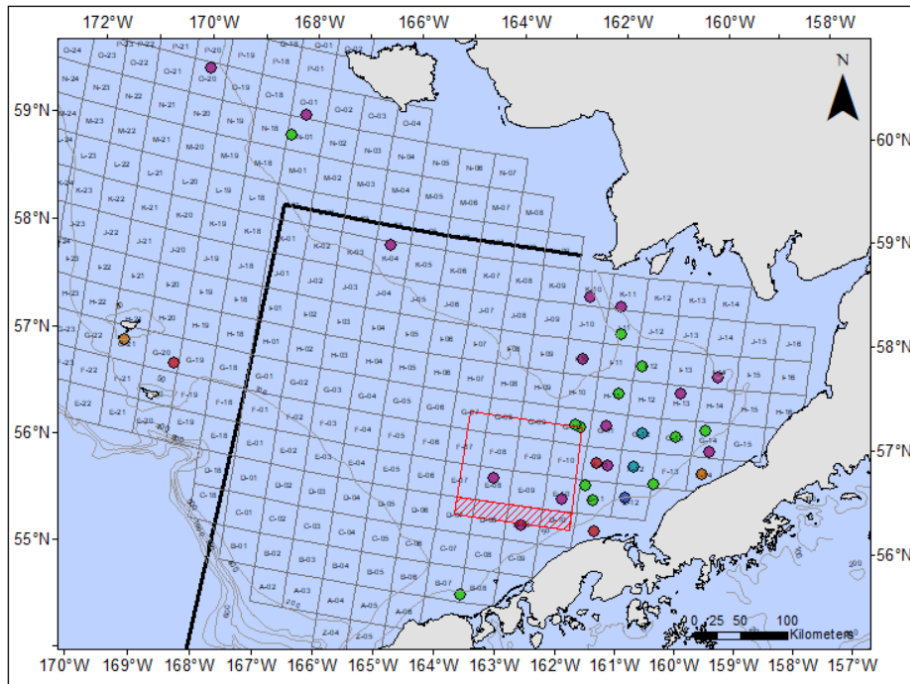


100 tags deployed on new hard-shell mature males

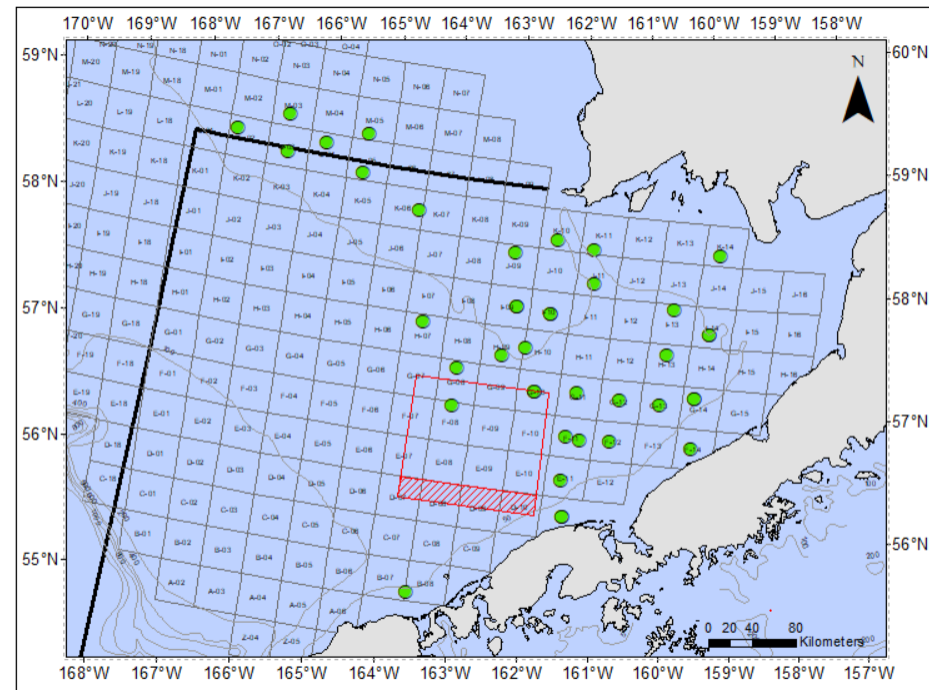


# Tagging Summer 2023

FEMALES (n=75)



MALES (n=40)



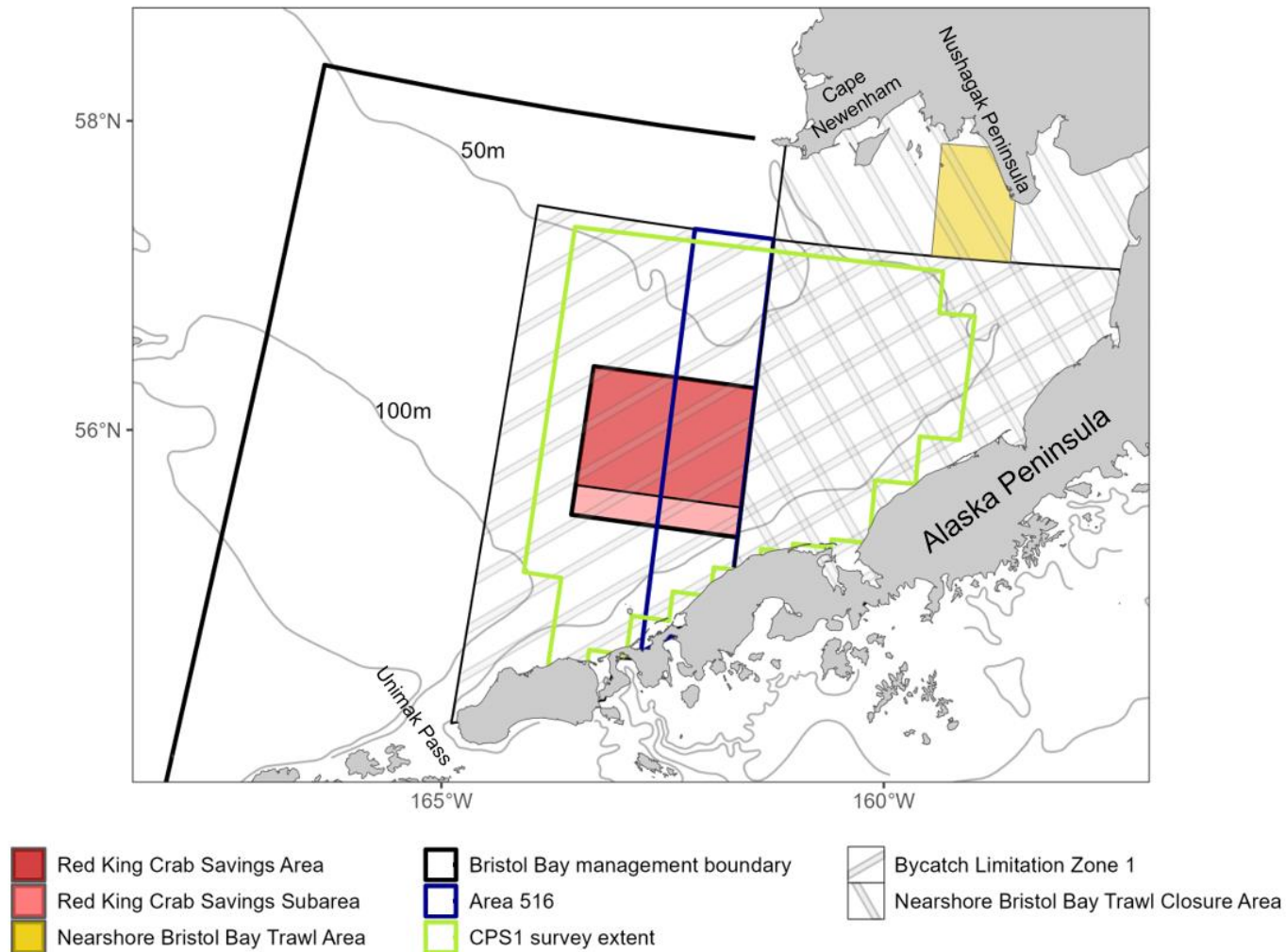


# CPS1 - Update

## Survey design

### 2023 BBRKC Collaborative Pot Sampling

Survey extent and closure areas

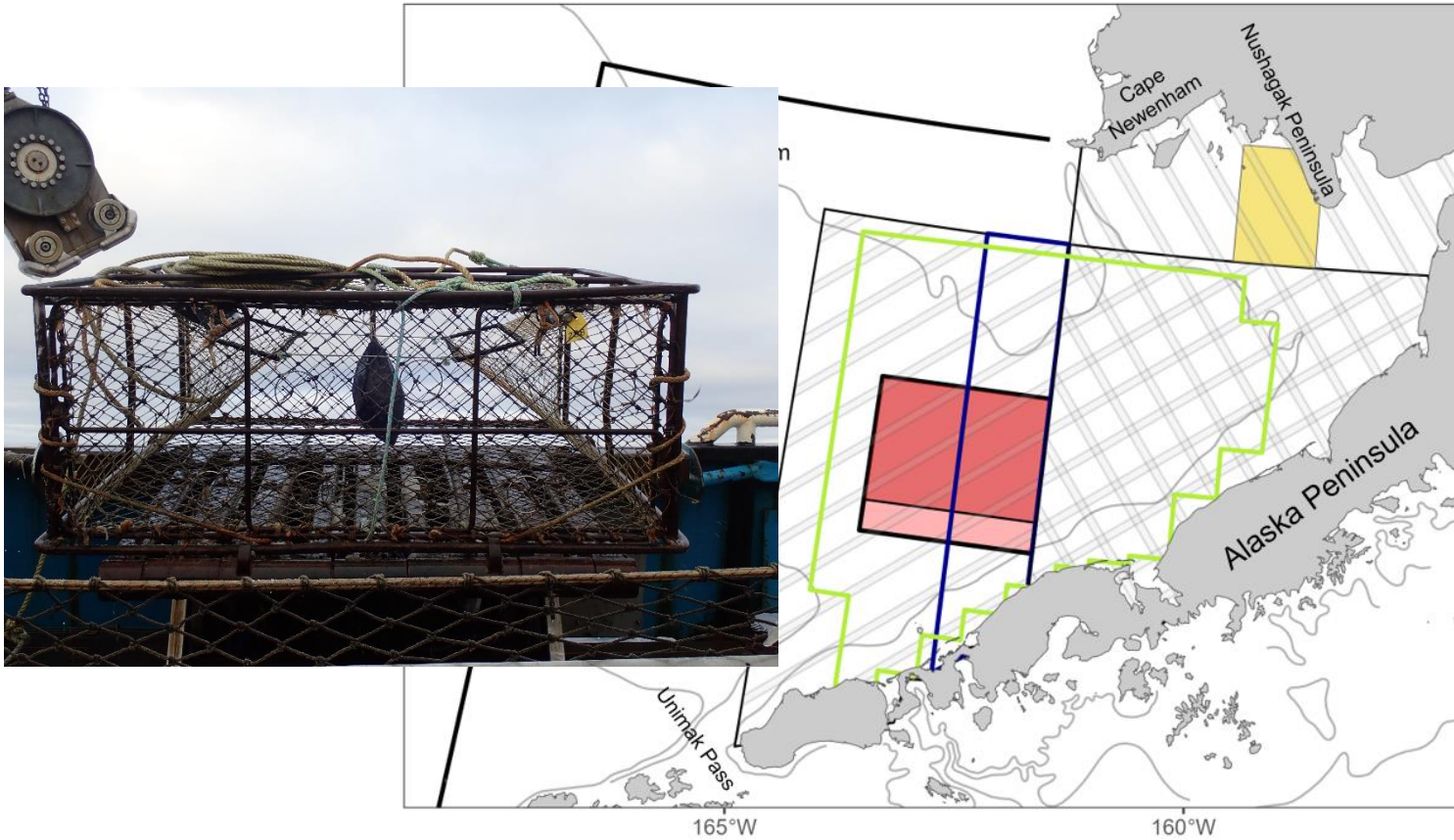


# CPS1 - Update

## Survey design

### 2023 BBRKC Collaborative Pot Sampling

Survey extent and closure areas



- Red King Crab Savings Area
- Red King Crab Savings Subarea
- Nearshore Bristol Bay Trawl Area

- Bristol Bay management boundary
- Area 516
- CPS1 survey extent

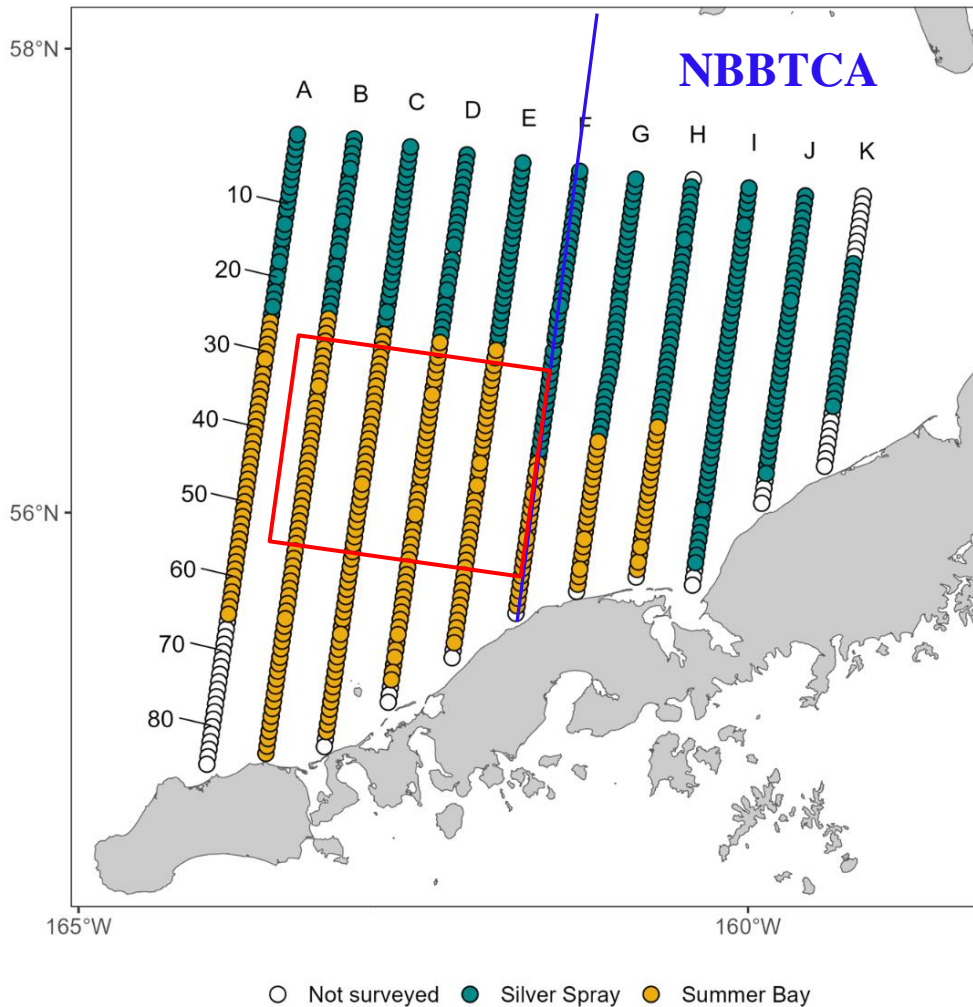
- Bycatch Limitation Zone 1
- Nearshore Bristol Bay Trawl Closure Area

# CPS1 - Update

## Survey design

2023 BBRKC Collaborative Pot Sampling

Survey vessel effort



- Full survey design =  
**692 stations**
  - 11 transects 15 nmi apart
  - stations spaced at 2 nmi along each transect
- Realized design =  
**637 stations**
  - 299 by F/V *Silver Spray*
  - 338 by F/V *Summer Bay*
  - plus additional stations for tagging, etc.
- Total catch:
  - 7,824 males
  - 2,367 females

# CPS1 - Update

## **Four primary types of information obtained:**

**1) Water temperature**

**2) Crab distribution**

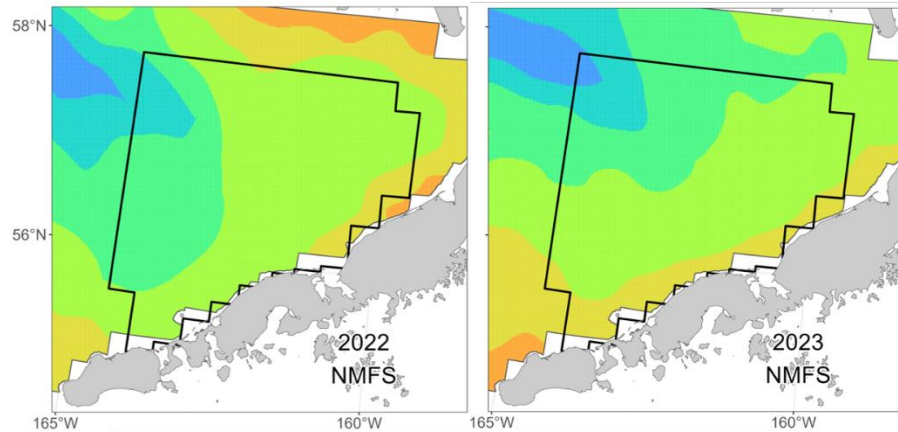
**3) Biological attributes**

- **Size**
- **Sex**
- **Shell condition**
- **Female maturity**
- **Egg clutch fullness and development stage**

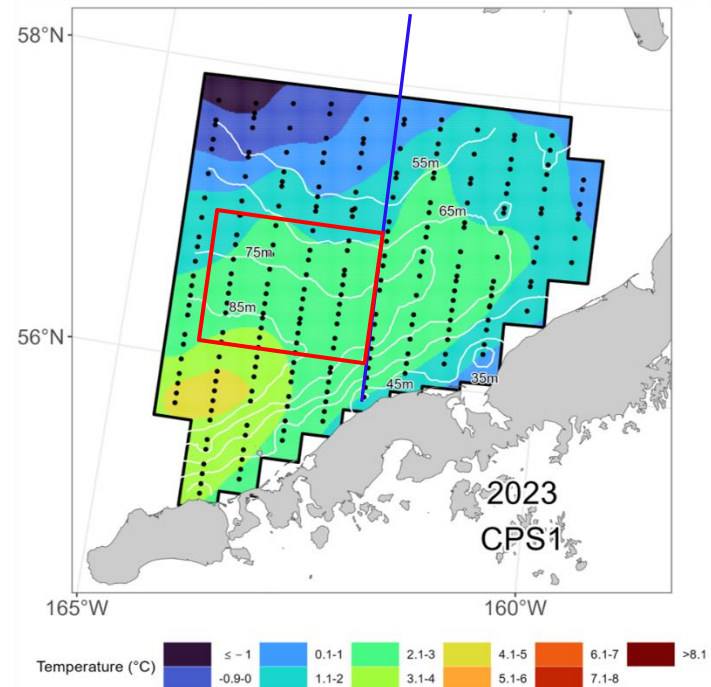
**4) Movement: from pop-up satellite tags**

# CPS1 - Update

## 1) Water temperature



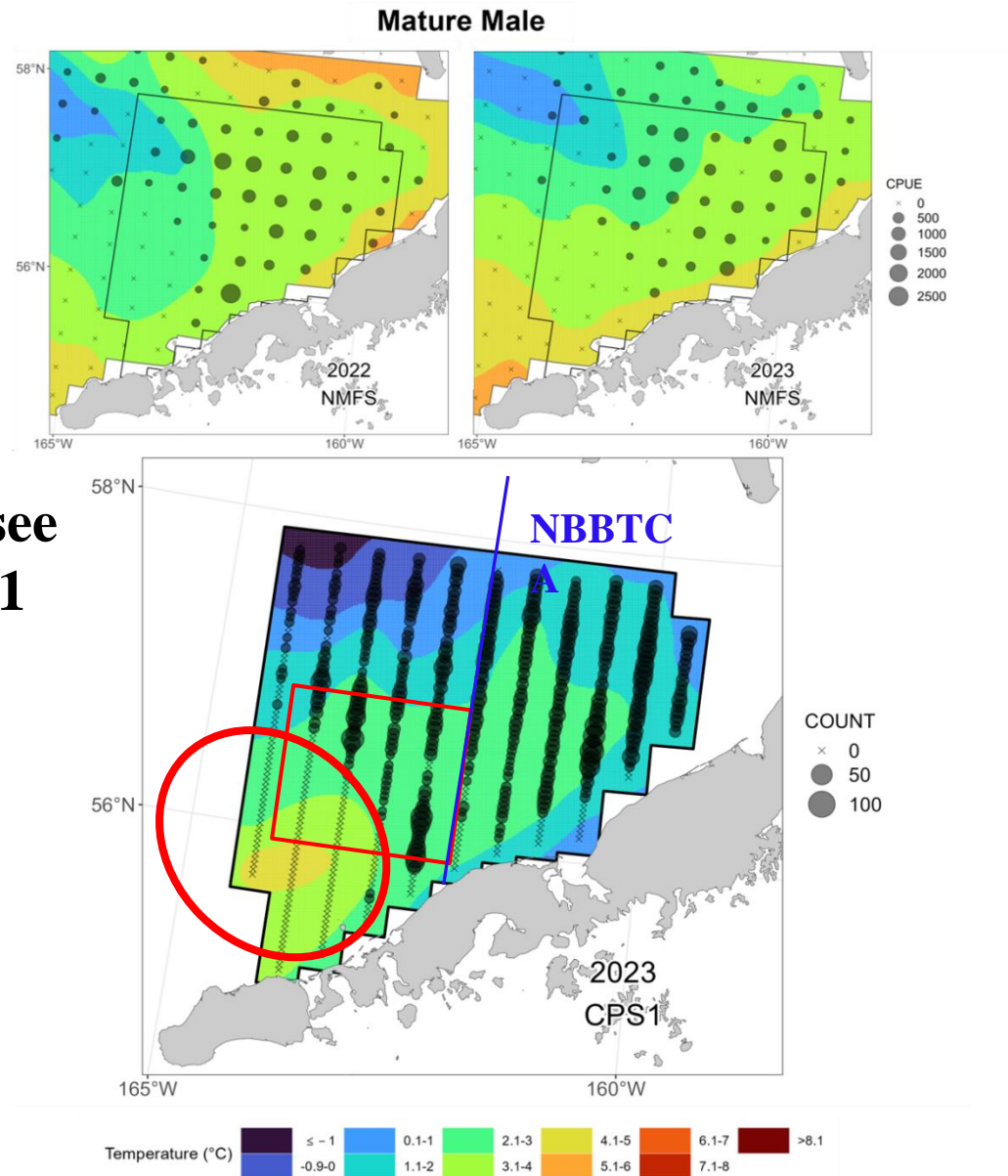
- Cooler than trawl survey
- Cold pool visible on the northwest corner of the grid



# CPS1 - Update

## 2) Crab distribution

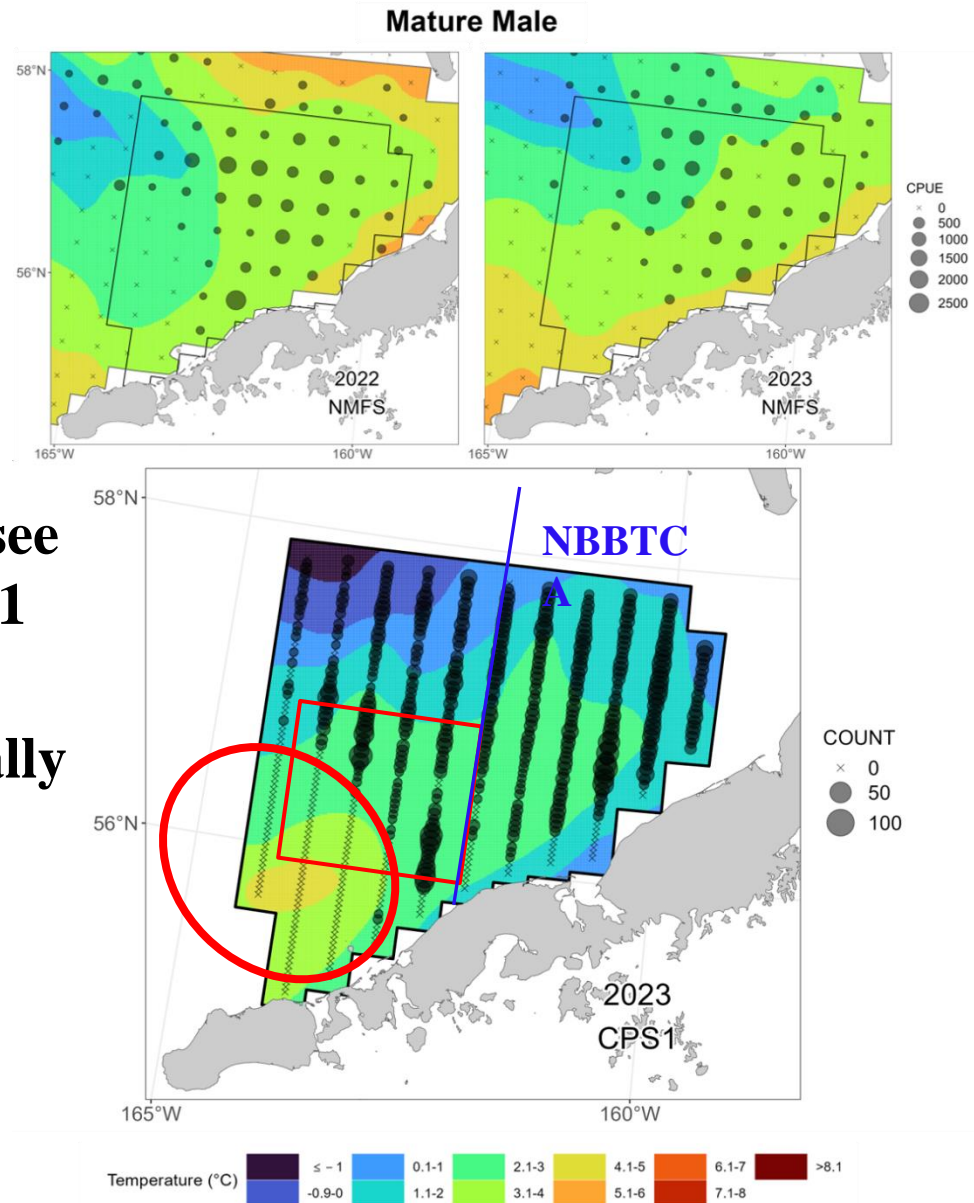
- Really need to squint to see differences between CPS1 and EBS trawl



# CPS1 - Update

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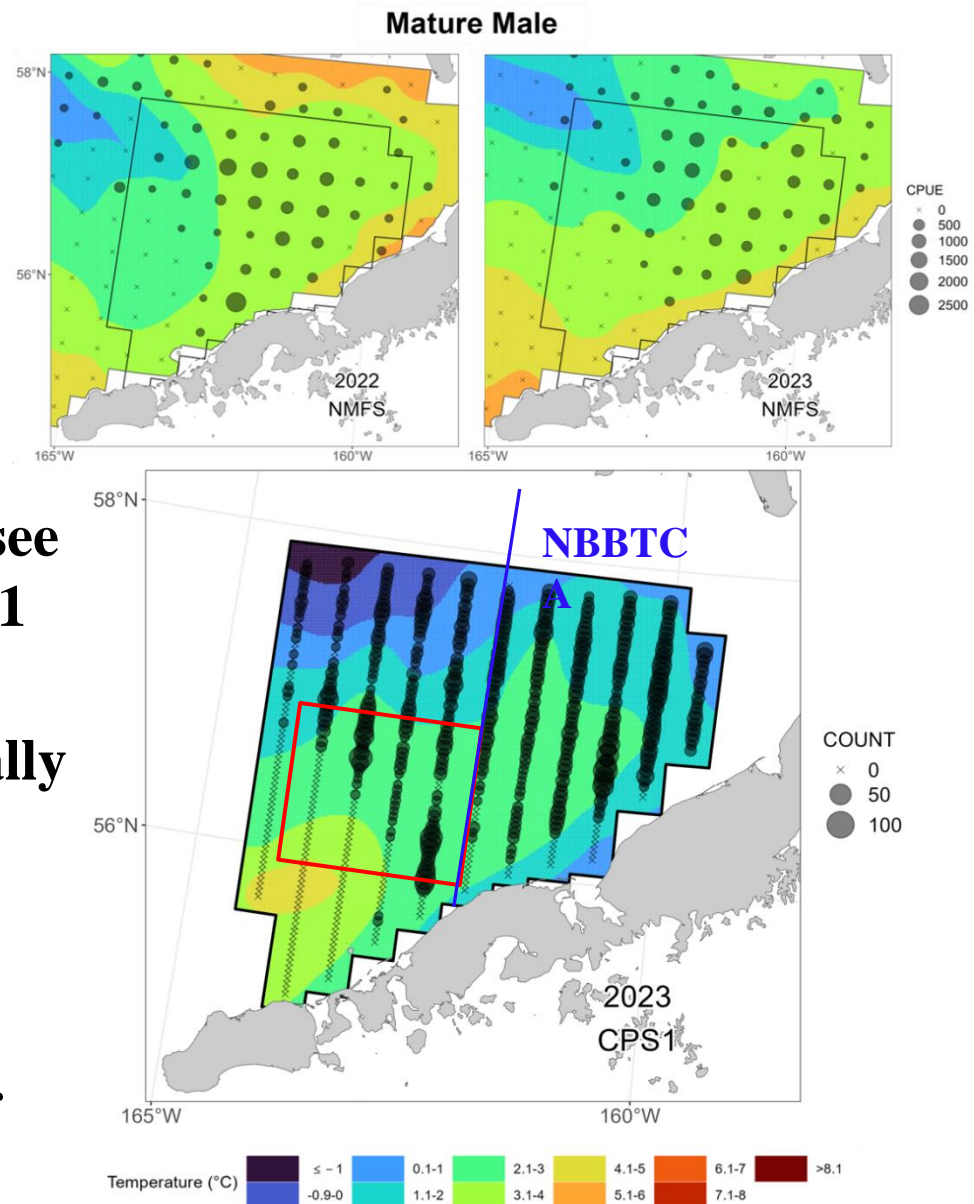
- Really need to squint to see differences between CPS1 and EBS trawl
- All demographics generally absent in the southwest



# CPS1 - Update

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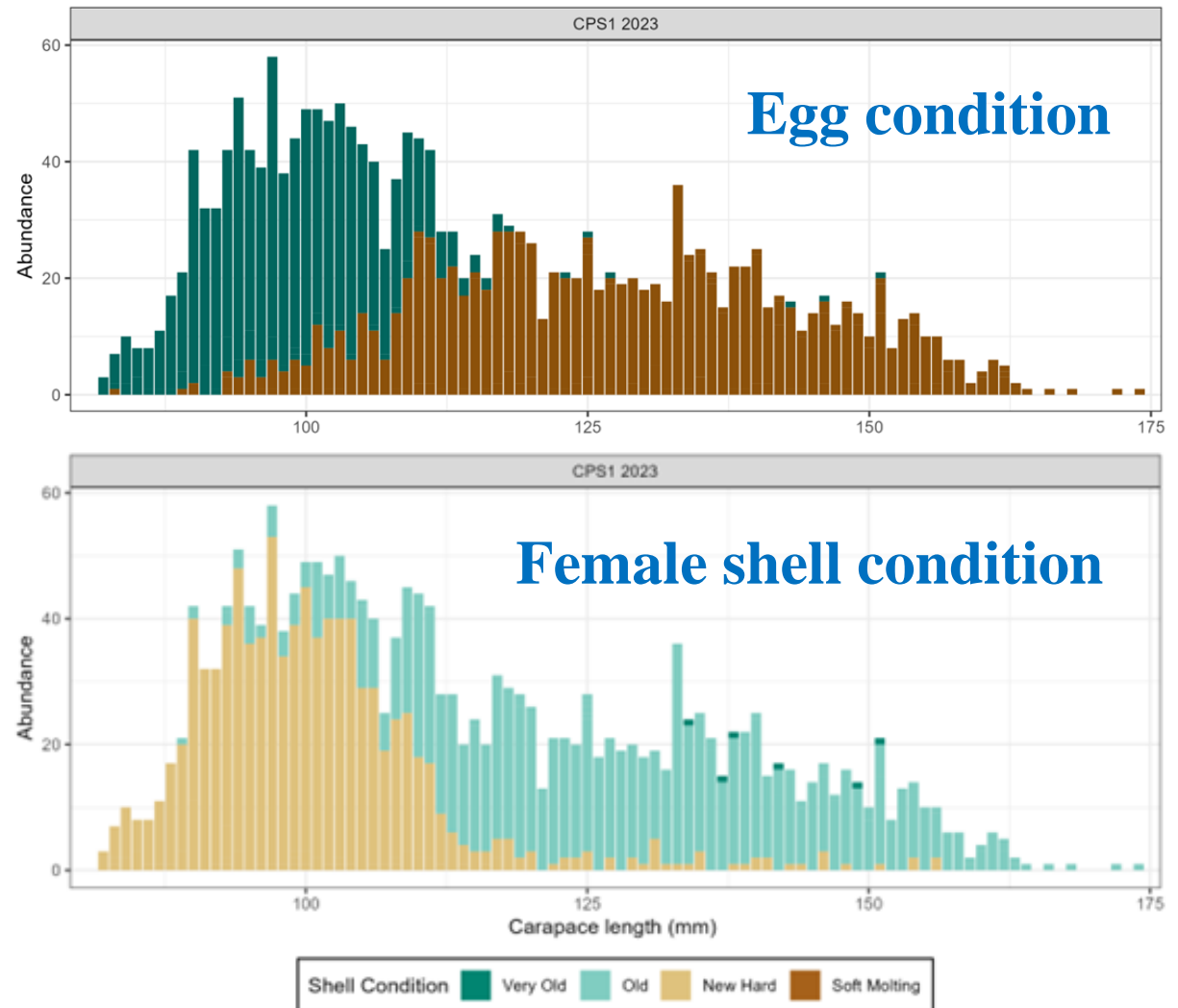
- Really need to squint to see differences between CPS1 and EBS trawl
- All demographics generally absent in the southwest
- Pot data *perhaps* more “smooth” than trawl?
- Spatial statistics in order





# CPS1 - Update

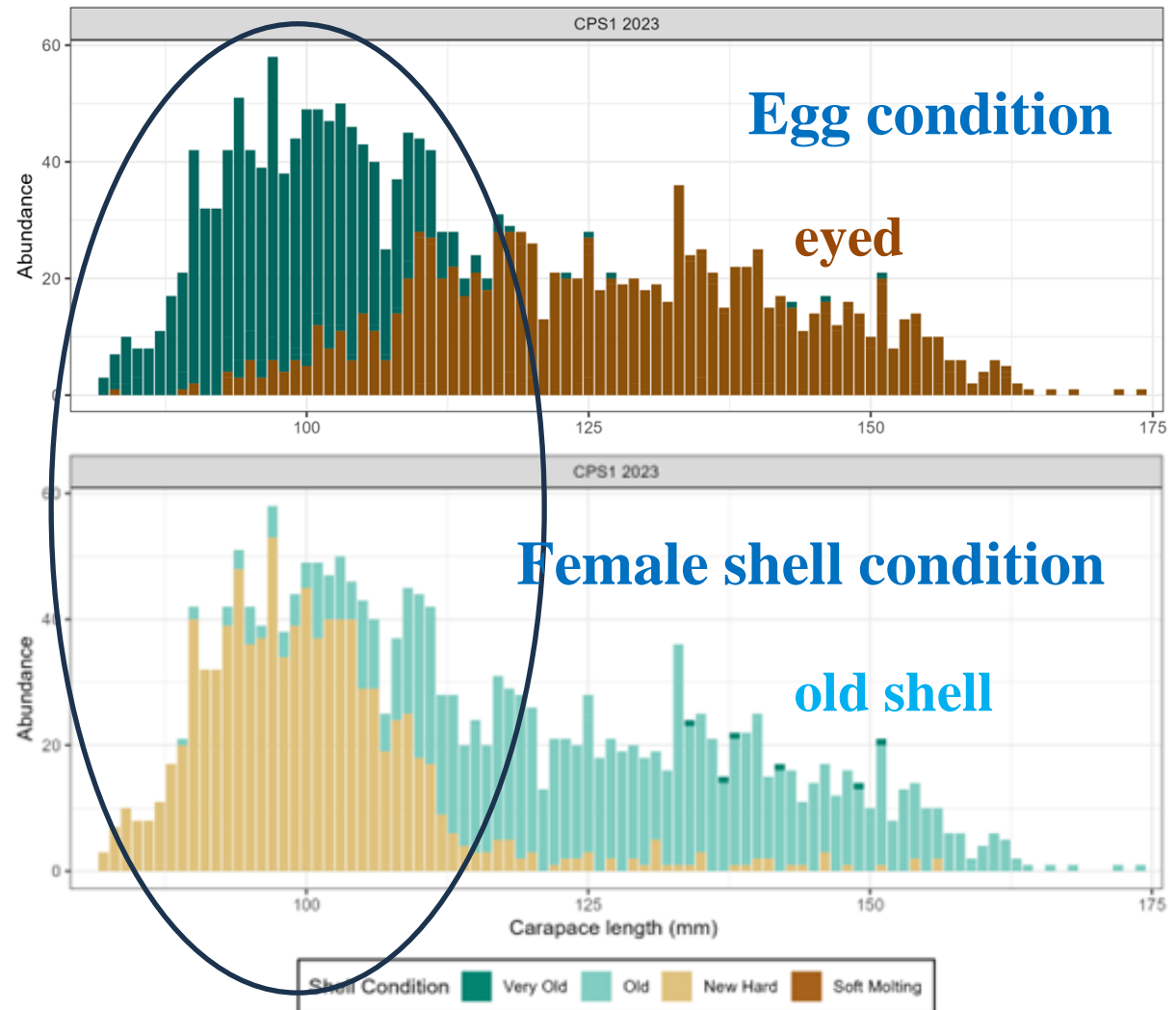
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# CPS1 - Update

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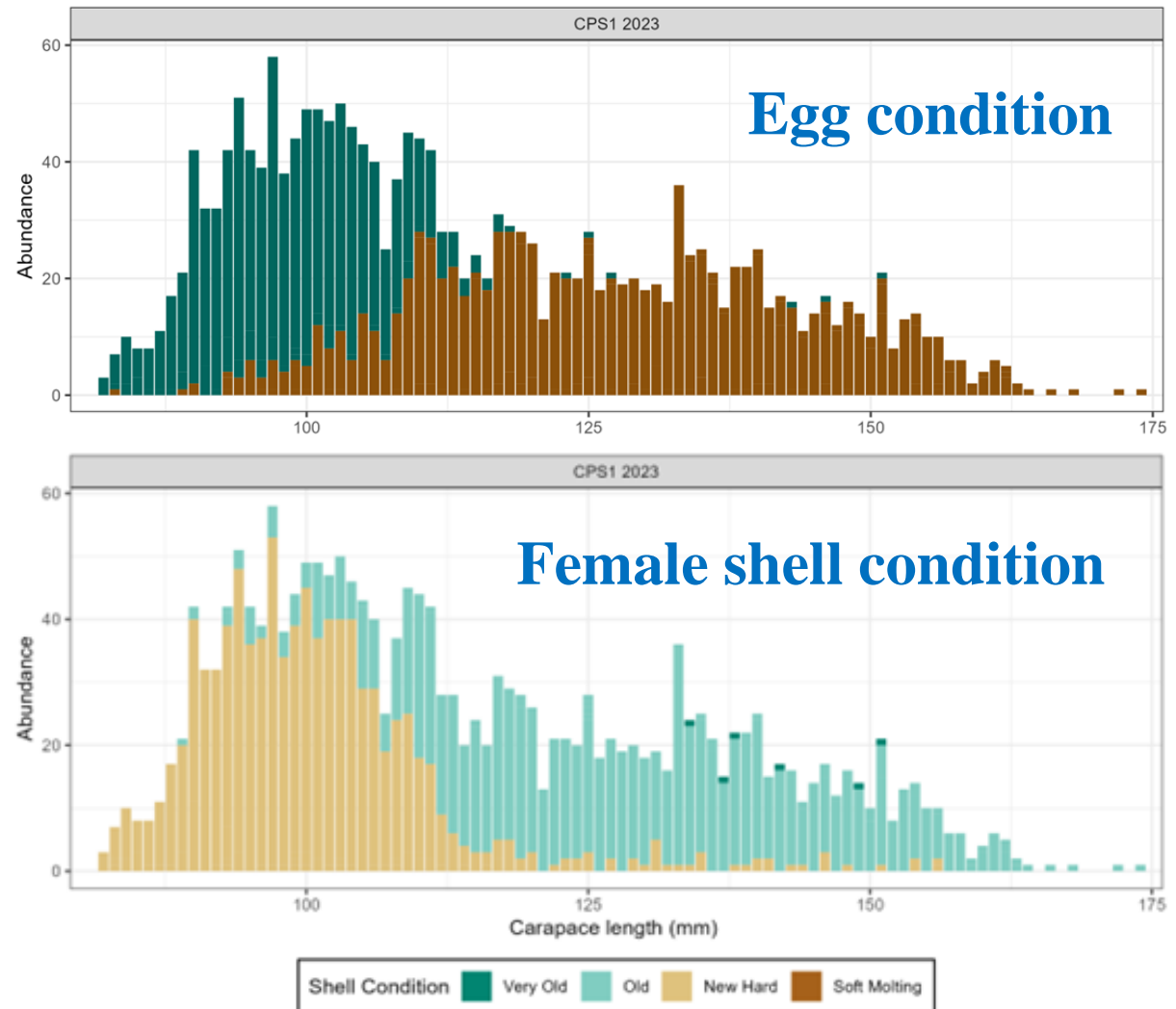
- Primiparous versus multiparous quite distinct



# CPS1 - Update

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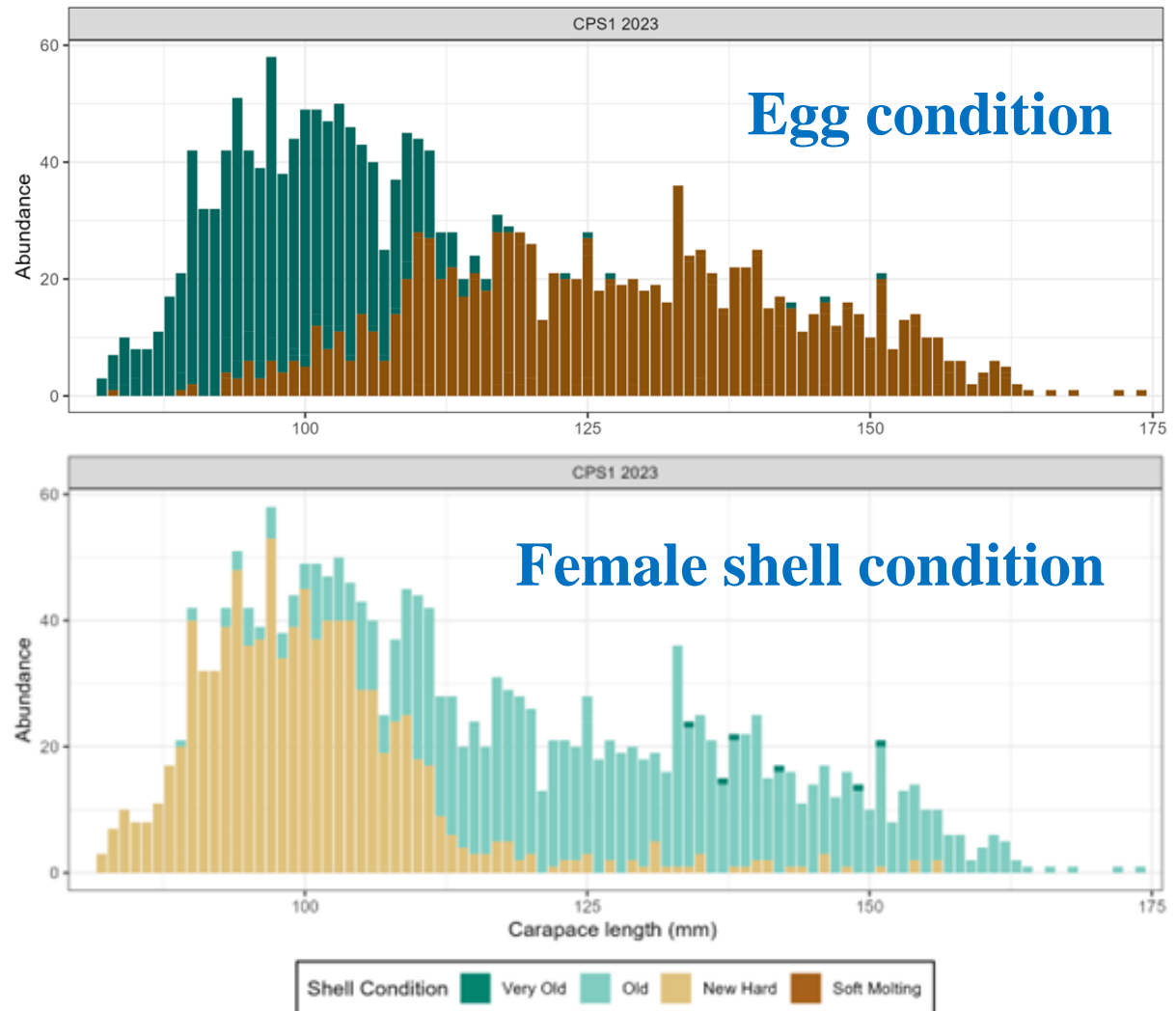
- Primiparous versus multiparous quite distinct
- Near absence of molting crabs: **pot-shy?**



# CPS1 - Update

## 3) Biological attributes: spawning dynamics

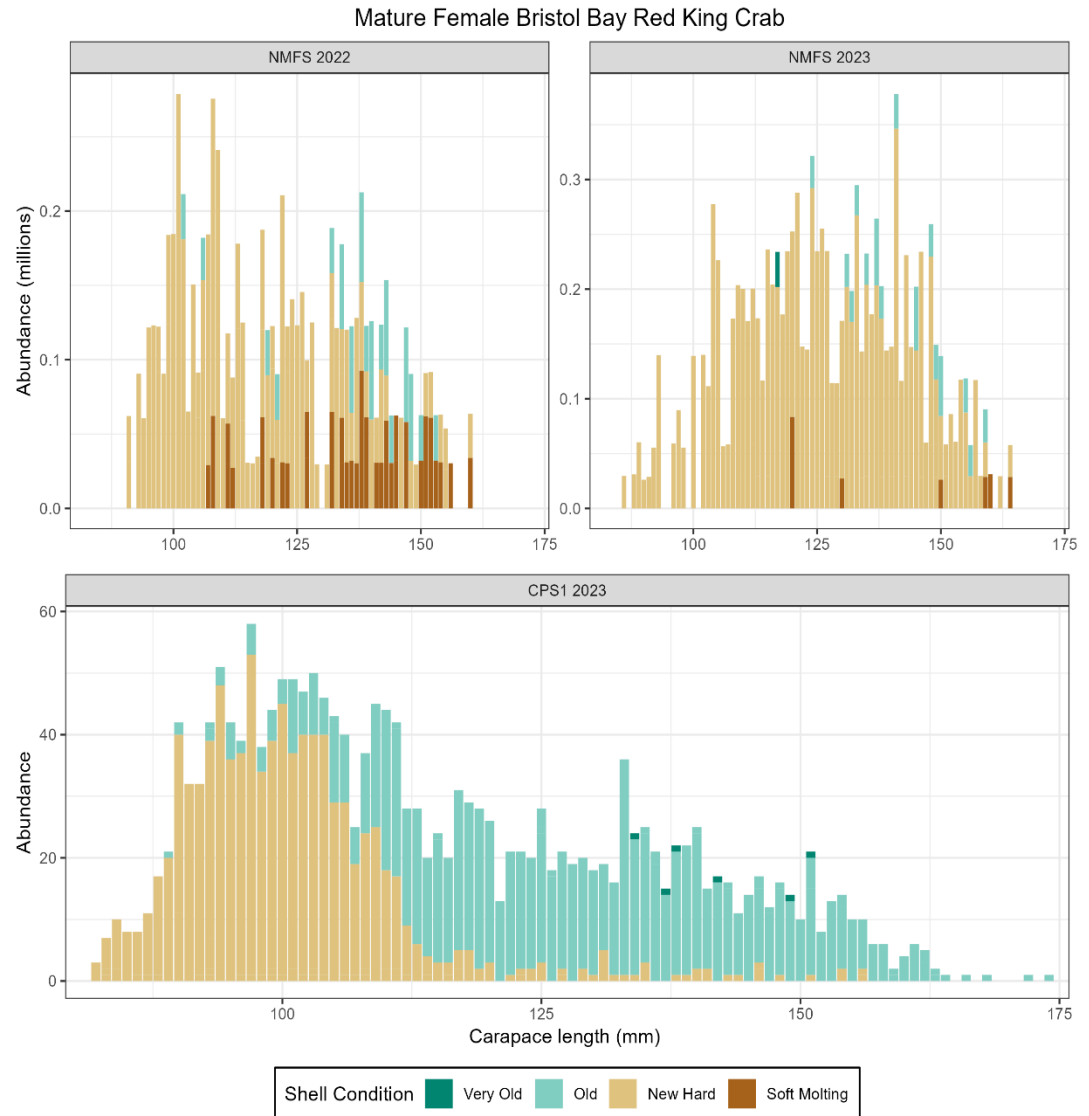
- Primiparous versus multiparous quite distinct
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- Complete absence of hatching embryos, empty egg cases: **do these females cease feeding, pre-molt?**



# CPS1 - Update

## 3) Biological attributes: spawning dynamics

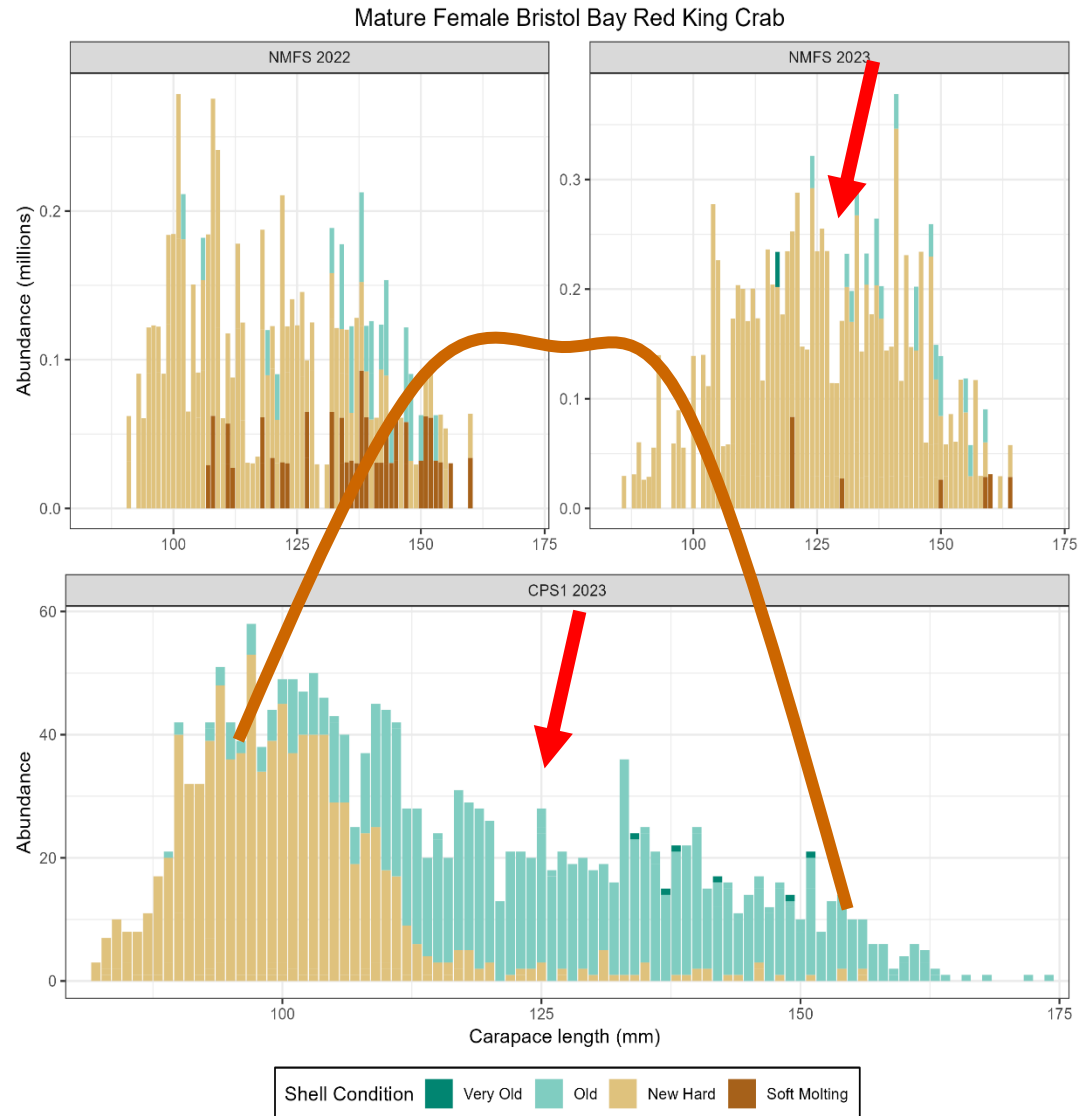
- **Primiparous versus multiparous quite distinct**
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# CPS1 - Update

## 3) Biological attributes: spawning dynamics

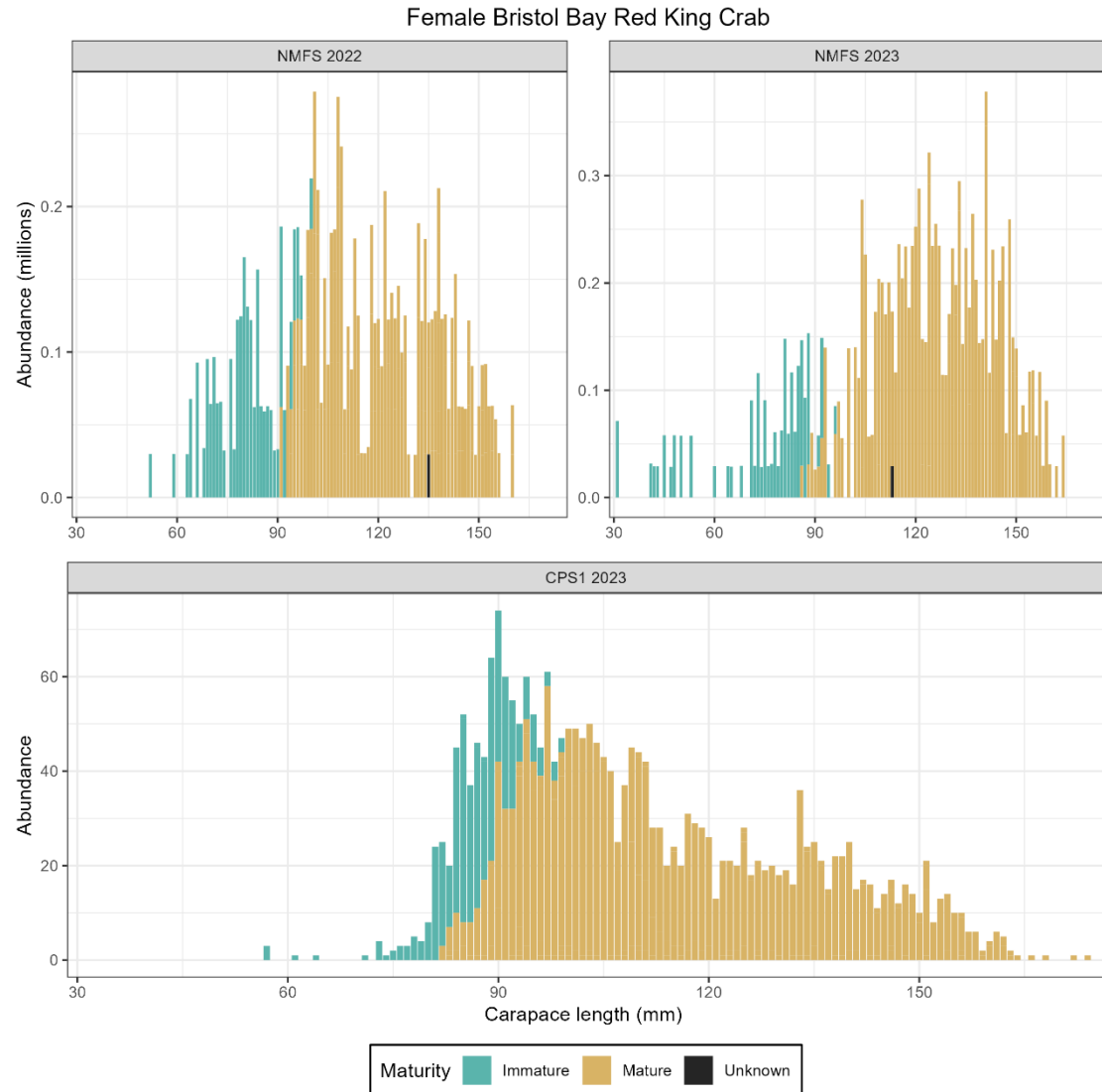
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# CPS1 - Update

## 3) Biological attributes: **maturation**

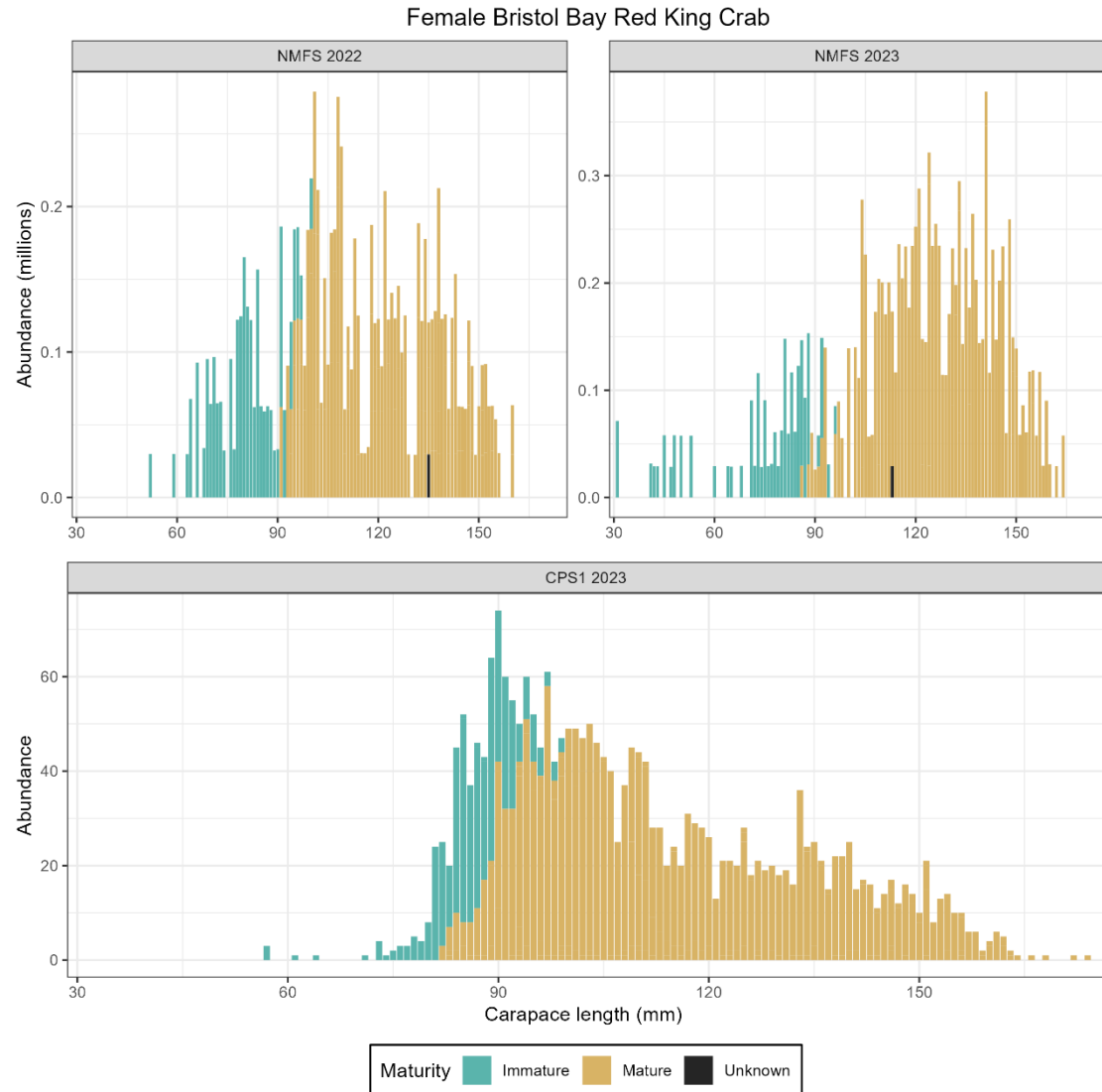
- **Broader range of sizes over which proportion mature is visible: **sample size or timing?****



# CPS1 - Update

## 3) Biological attributes: **maturation**

- **Broader range of sizes over which proportion mature is visible: **sample size or timing?****
- **But: **biased L50** without the missing multiparous females?**





# CPS1 - Update

**Looking forward: CPS2 and beyond**

# CPS1 - Update

## Looking forward: CPS2 and beyond

- Add a sampling method for some proportion of stations (*design-uncertain*): *Nephrops* trawl

# CPS1 - Update

## Looking forward: CPS2 and beyond

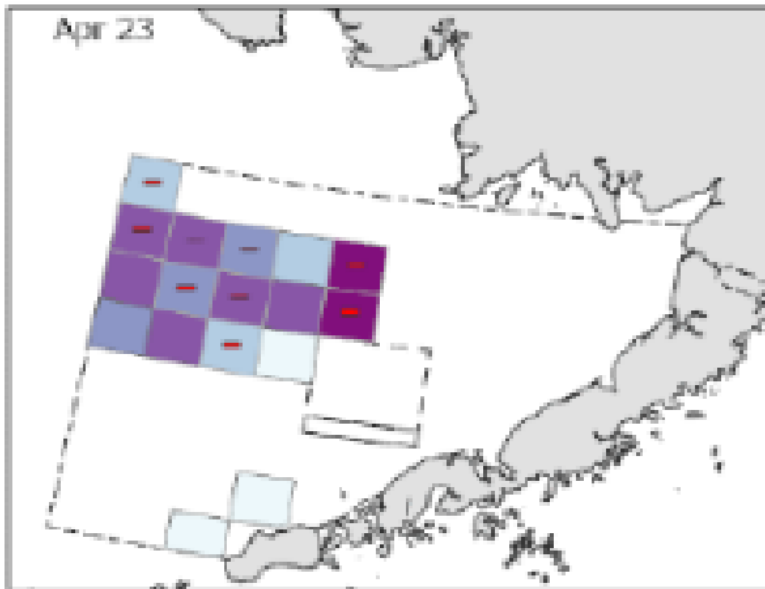
- **Add a sampling method: *Nephrops* trawl**
- **No satellite tags: not the best time of year to tag RKC**

# CPS1 - Update

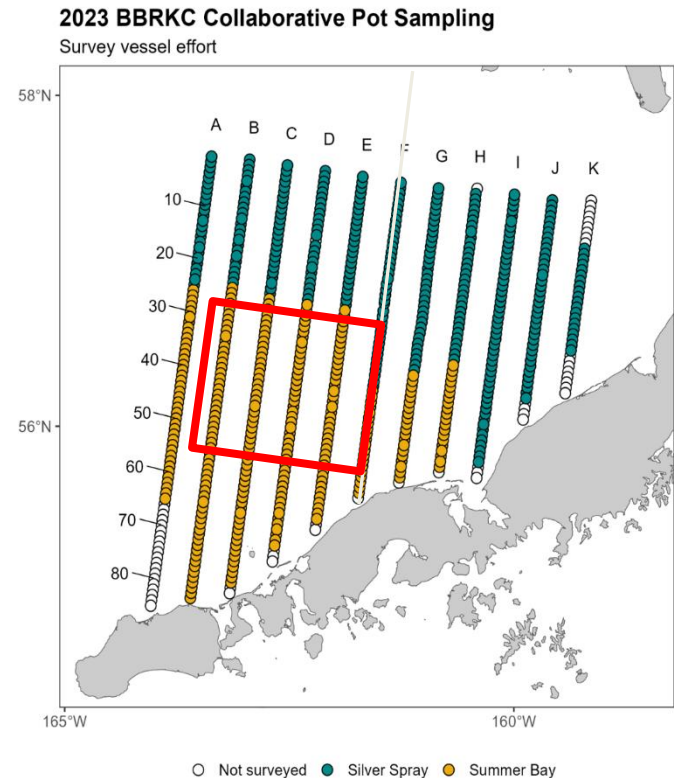
## Looking forward: CPS2 and beyond

- Add a sampling method: *Nephrops* trawl
- No satellite tags: not the best time of year to tag RKC
- Alteration of the footprint?

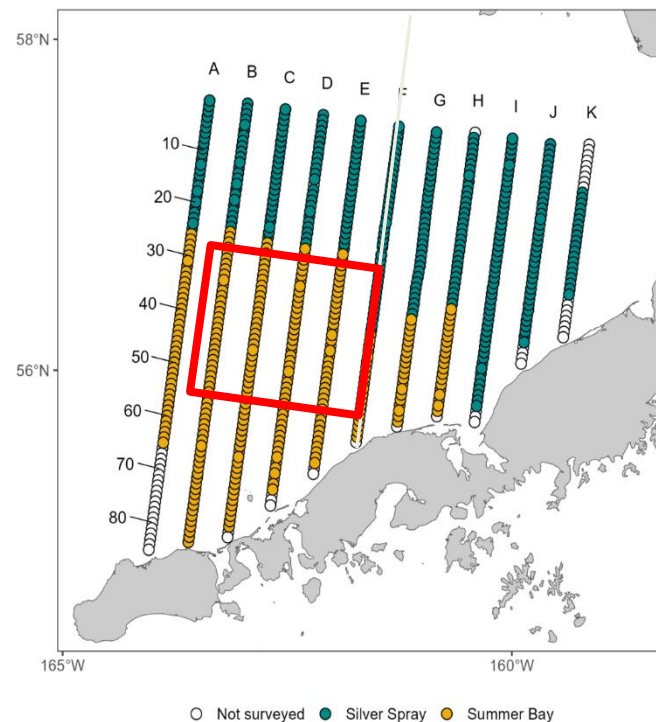
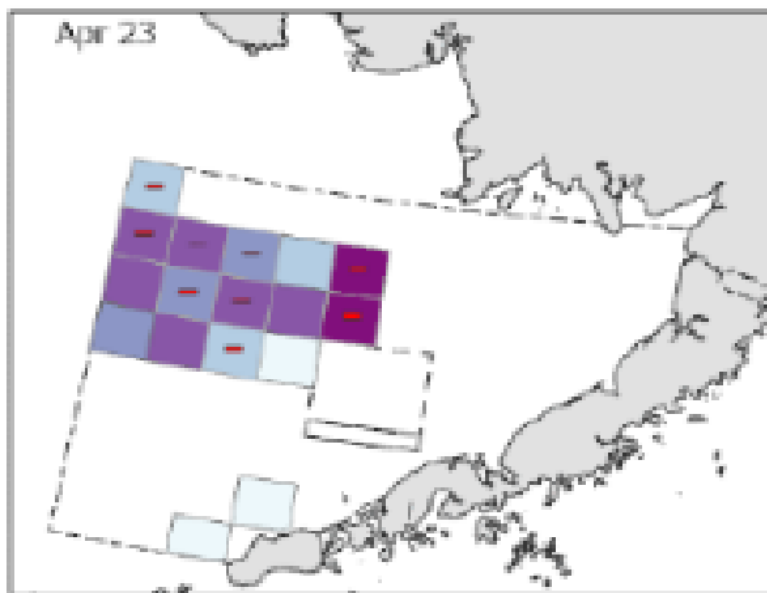
### Flatfish fishery effort: APRIL 2023



Graphic courtesy of Krista Milani (NMFS)

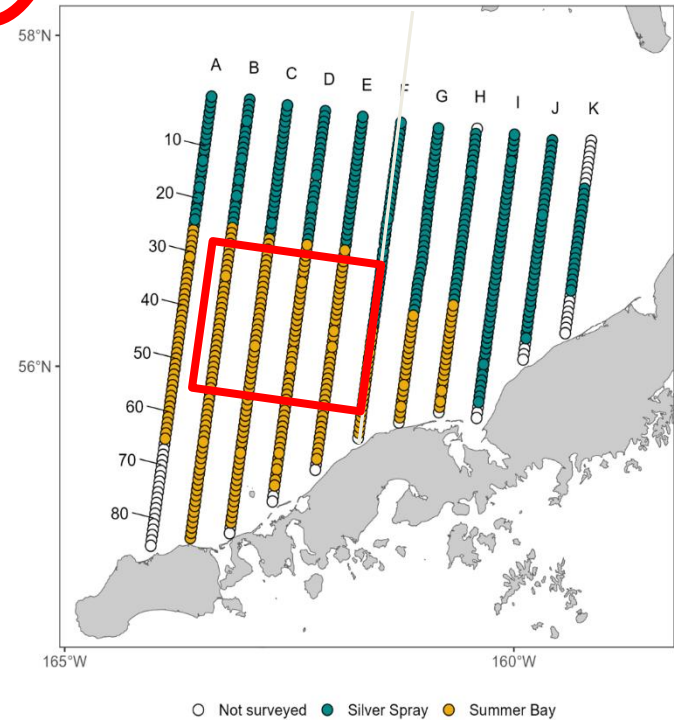
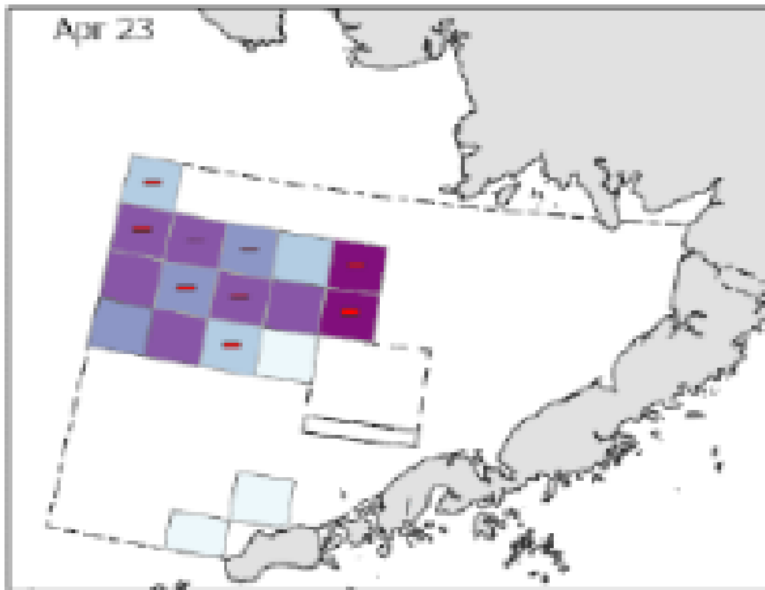


Demographic	Total	NBBTCA		RKCSA		RKCSS		BLZ1-W	
		#	%	#	%	#	%	#	%
Legal-size ( $\geq 135$ mm) males	3,498	2,160	61.7	689	19.7	66	1.9	649	18.6
Sublegal-size ( $< 135$ mm) males	4,326	2,796	64.6	804	18.6	308	7.1	726	16.8
Mature-size ( $\geq 120$ mm) males	5,000	3,098	62.0	979	19.6	122	2.4	923	18.5
Immature-size ( $< 120$ mm) males	2,824	1,858	65.8	514	18.2	252	8.9	452	16.0
Mature females	1,934	1,466	75.8	336	17.4	74	3.8	132	6.8
Immature females	433	307	70.9	33	7.6	9	2.1	93	21.5
Total catch	10,191	6,729	66.0	1,862	18.3	457	4.5	1,600	15.7



*Graphic courtesy of Krista Milani (NMFS)*

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# CPS1 - Update

## Looking forward: CPS2 and beyond

- **Add a sampling method: *Nephrops* trawl**
- **No satellite tags: not the best time of year to tag RKC**
- **Alteration of the footprint?**
- **Looking forward to discussions/guidance this fall, and review (with formal Operational Plan) prior to January CPT**

# CPS1 - Update

## Looking forward: reading material

- **Draft 1** of Tech Report coming imminently!
- “Beefier” **Draft 2** (added stats, tagging analyses, intriguing graphics, fuller Discussion, etc.) to be worked on this fall and available in advance of January CPT



# CPS1 – Acknowledgements-Thanks

ADFG/NOAA for direct project funding

Science team for planning

Science parties onboard for sampling

Vessels, captains, crews for their excellent work & help

Chris Siddon ADFG	Mike Litzow NOAA	Gary Stauffer BSFRF
Ben Daly ADFG	Leah Zacher NOAA	Silver Spray crew
Jared Weems ADFG	Emily Ryznar NOAA	Summer Bay crew
Vicki Vanek ADFG	Erin Fedewa NOAA	BSFRF Board of Directors
Katie Palof ADFG	Jamie Goen ABSC	ABSC Board of Directors
Mark Stichert ADFG	Charlie Heller NRC/BSFRF	Trident Seafoods
Ethan Nichols ADFG	Madison Heller-Shipley BSFRF	Fleet coordinators
Andy Nault ADFG	Gordon Kruse BSFRF	NOAA Seattle cameras
Corey Lescher ABSC	Scott Goodman BSFRF	Ocean Data Network

Big thanks to Emily Ryznar for coding/mapping/analyses

## ➤ Upcoming Research

- What's on the horizon?
- Several options to be ready for
- Pot sampling, camera work, trawl sampling, tagging charters, gear work, other research
- Coordinating with State of Alaska and NOAA and stakeholders - what next projects may be
- Charter options may be similar or more selective depending on the project(s)
- We are firming up research project plans now through SEP, CDS funds are available

# *SEP Crab Plan Team Update, Seattle*



Please feel free to reach out with questions anytime

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Dr. Gordon Kruse ([ghkruse@alaska.edu](mailto:ghkruse@alaska.edu))  
Ms. Madison Heller-Shipley ([mshipley@nrccorp.com](mailto:mshipley@nrccorp.com))  
Dr. Tim Loher ([tim.at.martingale@gmail.com](mailto:tim.at.martingale@gmail.com))